IN THE SPECIFICATION:

Please substitute the paragraph starting at page 19, line 8 and ending at line 21. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

--Figure 15 is a schematic view for explaining a sixth embodiment of the present invention. This embodiment is directed to a system in which an illumination optical system according to any one of the first to fifth embodiments is incorporated into an exposure apparatus for manufacture of semiconductor devices. In Figure 15, denoted at 30 is an illumination optical system such as described above. It functions to illuminate a mask 131 uniformly, which is placed at an imaging plane 6 or a plane optically conjugate therewith. Denoted at 132 is a projection optical system for lithographically transferring a circuit pattern, formed on the mask 131 onto a wafer which is coated with a resist.--.

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Please substitute the paragraph starting at page 19, line 22 and ending on page 20, line 1. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

--In this embodiment, the projection optical system 132 may comprise a unit magnification type mirror scann9ing

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optical system such as shown in Figure 1, or it may comprise a stepper reduction projection lens. Alternatively, this embodiment may be applied to an illumination optical system for a reduction type step-and-scan exposure apparatus (scanner).--.

Please substitute the paragraph starting at page 20, line 2 and ending at line 27. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

--When an illumination optical system according to the present invention is incorporated into an exposure apparatus such as described above, the following advantageous effects are obtainable. The luminous intensity distribution of illumination light such as shown in Figure 9 is emitted from the illumination optical system while the distribution being preserved, and it illuminates the mask 131 surface. Then, the light passes through the mask 131 surface (while a portion of the light is transformed into diffractive light), and it reaches the pupil plane 33 of the projection optical system 132. Upon this pupil plane 33, there is produced an illuminance distribution directly corresponding to the luminous intensity distribution at the mask 131 surface. Usually, this distribution is called an effective light source, and it is well know that the shape of this effective light source largely affects the resolution performance in pattern printing.

If the distribution has a Gaussian shape (small sigma) wherein the light intensity is large at a portion close to the optical axis (NA = 0) of the projection optical system 132, there is a tendency that, depending on the pattern, the resolution depth is expanded. Of course, the effect of high illumination efficiency through the illumination optical system 30 is held.--.

IN THE CLAIMS:

Please amend Claims 1-8, 11-18 and 22 as follows. A marked-up copy of Claims 1-8, 11-18 and 22, showing the changes made thereto, is attached. Please note that all claims currently pending in this application are being reproduced below for the Examiner's convenience.

1. (Amended) An illumination optical system, comprising:

a luminous intensity distribution converting optical system for converting an illuminance distribution of a lamp image into a luminous intensity distribution upon a predetermined plane;

a total reflection type light transmitting element having its light entrance surface disposed substantially in coincidence with the predetermined plane; and

a light collecting optical system for defining an illumination region upon a surface to be illuminated, by use of light from said light transmitting element.

2. (Amended) An illumination optical system according to Claim 1, wherein the illuminance distribution of the lamp image has an intensity which is higher at a portion adjacent to an optical axis than the intensity at a peripheral portion thereof.

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3. (Amended) An illumination optical system according to Claim 1, further comprising a lamp, and lamp image forming means for forming the lamp image by use of light from the lamp.

4. (Amended) An illumination optical system according to Claim 3, wherein said lamp image forming means includes an elliptical mirror having a focal point whereat the lamp is disposed, and wherein the lamp image is formed at another focal point of said mirror.

5. (Amended) An illumination optical system according to Claim 3, wherein the lamp comprises a Hg lamp.

6. (Amended) An illumination optical system according to Claim 1, said converting optical system includes first and second lens units having the same focal distance and being disposed so that a distance between principal points of the two lens units becomes equal to the focal distance, and wherein an entrance pupil of the first lens unit is disposed substantially in coincidence with the lamp image while an exit pupil of the second lens unit is disposed substantially in coincidence with the predetermined plane.

7. (Amended) An illumination optical system according to Claim 1, wherein said converting optical system includes an optical rod and a lens unit, wherein a light entrance surface of the optical rod is disposed substantially in coincidence with the lamp image, and wherein one focal point position of the lens unit is disposed substantially in coincidence with a light exit surface of the optical rod, while another focal point position of the lens unit is disposed substantially in coincidence with the predetermined plane.

8. (Amended) An illumination optical system according to Claim 1, wherein said converting optical system includes fly's eye lens and a lens unit, wherein a light entrance surface of the fly's eye lens is disposed substantially in

coincidence with the lamp image, and wherein one focal point position of the lens unit is disposed substantially in coincidence with a light exit surface of the fly's eye lens, while another focal point position of the lens unit is disposed substantially in coincidence with the predetermined plane.

9. (Not Amended) An illumination optical system according to Claim 1, wherein said light transmitting element comprises an optical fiber bundle.

10. (Not Amended) An illumination optical system according to Claim 9, wherein the optical fiber bundle has a light entrance face of one of square shape and rectangular shape, and a light exit fact of arcuate shape.

11. (Amended) An illumination optical system, comprising:

a luminous intensity distribution converting optical system for converting an illuminance distribution of a lamp image into a luminous intensity distribution upon a predetermined plane;

an optical fiber bundle having its light entrance surface disposed substantially in coincidence with the predetermined plane; and

a light collecting optical system for defining an illumination region upon a surface to be illuminated, by use of light from said optical fiber bundle.

12. (Amended) An illumination optical system according to Claim 11, wherein the illuminance distribution of the lamp image has an intensity which is higher at a portion adjacent to an optical axis than the intensity at a peripheral portion thereof.

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13. (Amended) An illumination optical system according to Claim 11, further comprising a lamp, and lamp image forming means for forming the lamp image by use of light from the lamp.

14. (Amended) An illumination optical system according to Claim 13, wherein said lamp image forming means includes an elliptical mirror having a focal point whereat the lamp is disposed, and wherein the lamp image is formed at another focal point of said mirror.

15. (Amended) An illumination optical system according to Claim 13, wherein the lamp comprises a Hg lamp.

16. (Amended) An illumination optical system according to Claim 11, said converting optical system includes first and second lens units having the same focal distance and being disposed so that a distance between principal points of the two lens units becomes equal to the focal distance, and wherein an entrance pupil of the first lens units is disposed substantially in coincidence with the lamp image while an exit pupil of the second lens unit is disposed substantially in coincidence with the predetermined plane.

17. (Amended) An illumination optical system according to Claim 11, wherein said converting optical system includes an optical rod and a lens unit, wherein a light entrance surface of the optical rod is disposed substantially in coincidence with the lamp image, and wherein one focal point position of the lens unit is disposed substantially in coincidence with a light exit surface of the optical rod, while another focal point position of the lens unit is disposed substantially in coincidence with the predetermined plane.

18. (Amended) An illumination optical system according to Claim 11, wherein said converting optical system includes a fly's eye lens and a lens unit, wherein a light entrance surface of the fly's eye lens is disposed substantially

in coincidence with the lamp image, and wherein one focal point position of the lens unit is disposed substantially in coincidence with a light exit surface of the fly's eye lens, while another focal point position of the lens unit is disposed substantially in coincidence with the predetermined plane.

19. (Not Amended) An illumination optical system according to Claim 11 wherein said optical fiber bundle has a light entrance of one of square shape and rectangular shape, and a light exit face of arcuate shape.

20. (Not Amended) An illumination optical system according to Claim 11, wherein said optical fiber bundle comprises a total reflection type fiber bundle.

21. (Not Amended) An illumination optical system according to Claim 11, wherein said optical fiber bundle comprises a distributed refractivity type optical fiber bundle.

22. (Amended) An illumination optical system for use in an exposure apparatus for illuminating a mask having a pattern formed thereon and for projecting the pattern onto a substrate by projection exposure, said illumination optical system, comprising:

a luminous intensity distribution converting optical system for converting a luminous intensity distribution of plural light fluxes having different incidence angles into an illuminance distribution upon a predetermined plane;

a total reflection type light transmitting element having its light entrance surface disposed substantially in coincidence with the predetermined plane; and

a light collecting optical system for defining an illumination region upon the mask, by use of light from said light transmitting element.

23. (Not Amended) An illumination optical system according to Claim 22, wherein said light transmitting element comprises an optical rod.

24. (Not Amended) An illumination optical system according to Claim 22, wherein the plural light fluxes are supplied by a plurality of laser light sources.

25. (Not Amended) An exposure apparatus, comprising:

an illumination optical system as recited in any one of Claims 1 – 24; and

a projection optical system for transferring, by exposure, a pattern of a mask as illuminated with said illumination optical system, onto a wafer.

26. (Not Amended) A device manufacturing method, comprising steps of:

applying a resist to a wafer;

transferring, by exposure, a pattern of a mask onto the wafer by use of an exposure apparatus as recited in Claim 25; and

developing the wafer having the pattern transferred thereto.

Please add Claims 27 and 28 as follows:

--27. An illumination optical system for use in an exposure apparatus for illuminating a mask having a pattern formed thereon and for projecting the pattern onto a substrate by projection exposure, said illumination optical system comprising:

a luminous intensity distribution converting optical system for converting an illuminance distribution of a lamp image into a luminous intensity distribution upon a predetermined plane;

a total reflection type light transmitting element having its light entrance surface disposed substantially in coincidence with the predetermined plane; and

a light collecting optical system for defining an illumination region upon the mask, by use of light from said light transmitting element.

28. An illumination optical system for use in an exposure apparatus for illuminating a mask having a pattern formed thereon and for projecting the pattern onto a substrate by projection exposure, said illumination optical system comprising:

a luminous intensity distribution converting optical system for converting an illuminance distribution of a lamp image into a luminous intensity distribution upon a predetermined plane;

an optical fiber bundle having its light entrance surface disposed substantially in coincidence with the predetermined plane; and

a light collecting optical system for defining an illumination region upon the mask, by use of light from said optical fiber bundle.